

## REMARKS

### Claim Rejections Under 35 USC §103

Claims 24, 25, 34 and 35 have been rejected under 35 USC 103(a) as being unpatentable over the admitted prior art (APA) in view of Lee et al. (U.S. Patent No. 5,796,586).

Claims 26-33 and 36 have been rejected under 35 USC §103(a) as being unpatentable over the admitted prior art (APA) in view of Lee et al. (U.S. Patent No. 5,796,586), as applied to claims 24 and 34 above, and further in view of Hoffman et al. (U.S. Patent No. 5,360,942).

### Argument

The rejections under 35 USC §103 are traversed as the cited combination of references does not disclose all of the features of the presently claimed semiconductor package as required by MPEP 2142, 2143. Specifically, the present package is a board on chip package 62 (Figure 7) having the face of the die 16 (Figure 7) bonded directly to the substrate 56 (Figure 7). In the APA package 10 (Figure 1A) the face of the die 16 (Figure 1A) is bonded to the solder mask 22 (Figure 1A), rather than directly to the substrate 12. Because the face of the die 16 is bonded directly to the substrate 56, the present package 62 provides improved adhesion of the die 16 to the substrate 56, and improved heat transfer from the die 16 to the substrate 56.

In Lee et al. the die 220 (Figure 6) is back bonded to the substrate 216 (Figure 6) in a chip on board configuration, and the face of the die 220 faces away from the substrate 216. Although the back of the die 220 transfers heat to the substrate 216, the face of the die, where most of the heat is generated, does not transfer heat directly to the substrate 216. The combination of the APA and Lee et al. thus does not include the feature of the face of the die being bonded directly to the substrate. In

order to emphasize this feature, all of the amended independent claims include the recitation of the face of the die being bonded "directly" to the substrate. Antecedent basis for this recitation is provided on page 5, line 14, of the specification.

Another indicia of the unobviousness of the presently claimed package is it's improved performance over prior art semiconductor packages. As held in Graham v. John Deere, 383 U.S. 1, 13, 148 U.S.P.Q. 459, 465 (1966), the results and advantages of an invention over the prior art are to be considered in assessing unobviousness. In this regard, the presently claimed package has improved heat transfer characteristics over prior art packages, particularly where a filled adhesive layer 72 (Figure 7) is used between the die 16 and the substrate 56. As stated in independent claim 30, the filled adhesive layer is "configured to transfer heat directly from the face to the substrate". Although filled adhesive layers, as exemplified by Hoffman et al., are known in the art, they have not been heretofore used in a semiconductor package having the presently claimed configuration of a die face bonded through an opening in a solder mask directly to a substrate.

Yet another feature of the present package not disclosed by the cited combination of APA and Lee et al. is that the die attach area has an outline that is "only slightly larger" than that of the die. This recitation is contained in amended dependent claims 25, 29 and 31, and in amended independent claim 34. Antecedent basis for this recitation is provided on page 11, lines 24-25 of the specification. In the embodiment shown in Figure 7 of Lee et al., the outline of the die attach area 204 is larger than that of the die to accommodate wire bonds 222 (Figure 6) between the die 220 and the conductive traces 202 (Figure 7). As wire bonds typically have a length measured in millimeters, the outline of the die attach area 204 in

Lee et al. would be substantially larger than that of the die 220.

Applicant would further argue that one skilled in the art at the time of the invention would have no incentive to combine APA and Lee et al., as required by MPEP 2142, 2143. In support of the combination, the Office Action states the incentive as "so that the bonding to the substrate and the reliability of the package can be improved in the APA." However, there is no teaching in Lee et al. that bonding of the die to the substrate can be improved. Rather, Lee et al. is concerned with the adhesion of the encasing material (i.e., encapsulant) to the substrate (column 2, lines 61-63, column 3, lines 22-25). That is why the encasing material 224 in Figures 5 and 6 of Lee et al. covers such a large area of the substrate 216, as the area of contact between the encasing material 224 and the substrate 216 is being maximized.

Although it appears the Examiner has interpreted lines 8-11 of the Abstract of Lee et al. as teaching improved die adhesion to the substrate, a reading of the Lee et al. specification does not support this interpretation. Rather, the teaching in Lee et al. is improved adhesion of the encasing material to the substrate, not improved adhesion of the die to the substrate. Although the improved die-substrate adhesion concept is present in the present specification, it is improper hindsight in assessing unobviousness of the present claims. As held in Loctite Corp. v. Ultraseal Ltd., 781 F.2d 861, 228 USPQ 90 (Fed Cir. 1985), it is not permissible to depart from the statutory standard of unobviousness "to the tempting but forbidden zone of hindsight".

In the embodiment shown in Figure 7 of Lee et al. the solder mask 218' is large because it protects the conductive traces (column 7, lines 56-58). However, in the present package 62 (Figure 7) there are no conductive traces on the surface of the substrate 56 to which the die

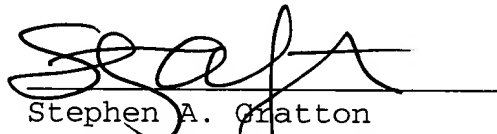
16 is bonded. One skilled in the art at the time of the invention would thus have no incentive to make the proposed combination of APA, and the Figure 7 embodiment of Lee et al.

Conclusion

In view of the above arguments and amendments, favorable consideration and allowance of claims 24-36 is respectfully requested. Should any issues arise that will advance this case to allowance, the Examiner is asked to contact the undersigned by telephone.

DATED this 16th day of September, 2003.

Respectfully submitted:

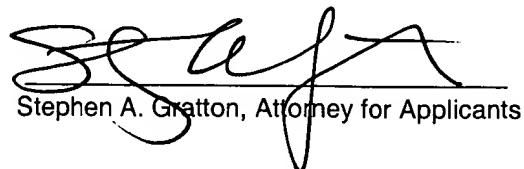
  
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